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ABSTRACT

This document, which is intended for use by community and junior colleges throughout Mississippi, contains curriculum frameworks for the course sequences in the welding and cutting programs cluster. Presented in the introductory section are a description of the program and suggested course sequence. Section I lists baseline competencies, and section II consists of outlines for each of the following courses in the sequence: shielded metal arc welding, gas metal arc welding, welding inspection and testing principles, gas tungsten arc welding, flux cored arc welding, drawing and welding symbol interpretation, pipe welding, gas metal arc aluminum welding, plasma arc cutting, oxyfuel gas cutting principles and practices, air carbon arc cutting and gouging, advanced pipe welding, special problem in welding and cutting, and work-based learning in welding and cutting. Each course outline contains some/all of the following: course name and abbreviation; course classification; course description; prerequisites; and competencies and suggested objectives. Recommended tools and equipment are listed in section III. Appended are lists of related academic topics and workplace skills for the 21st century and student competency profiles for both courses. (YLB)

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ED 397 326

# Mississippi Curriculum Framework for Welding and Cutting

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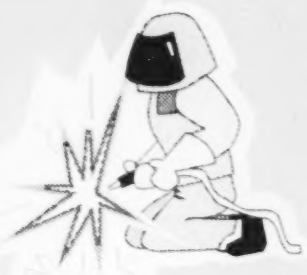

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*Postsecondary*
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# MISSISSIPPI

# CURRICULUM FRAMEWORK

# FOR

# WELDING AND CUTTING PROGRAMS

(PROGRAM CIP: 48.0508 - Welder/Welding Technologist)

POSTSECONDARY PROGRAMS 1996

July 30, 1996

Direct inquiries to:

Program Coordinator
Trade, Industrial and Related Technology
Office of Vocational and Technical Education
Mississippi Department of Education
P. O. Box 771
Jackson, MS 39205
(601) 359-3475

For copies of this publication, contact:

Research and Curriculum Unit
Mississippi State University
P. O. Drawer DX
Mississippi State, MS 39762
(601) 325-2510

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# FOREWORD

In order to survive in today's global economy, businesses and industries have had to adopt new practices and procedures. Total quality management, statistical process control, participatory management, and other concepts of high performance work organizations are practices by which successful companies survive. Employers now expect their employees to be able to read, write, and communicate effectively; solve problems and make decisions; and interact with the technologies that are prevalent in today's workplace. Vocational-technical education programs must also adopt these practices in order to provide graduates who can enter and advance in the changing work world.

The curriculum framework in this document reflects these changes in the workplace and a number of other factors that impact on local vocational-technical programs. Federal and state legislation calls for articulation between high school and community college programs, integration of academic and vocational skills, and the development of sequential courses of study that provide students with the optimum educational path for achieving successful employment. National skills standards, developed by industry groups and sponsored by the U. S. Departments of Education and Labor, provide vocational educators with the expectations of employers across the United States. All of these factors are reflected in the framework found in this document.

Each postsecondary program of instruction consists of a program description and a suggested sequence of courses which focus on the development of occupational competencies. Each vocational-technical course in this sequence has been written using a common format which includes the following components:

- Course Name - A common name that will be used by all community/junior colleges in reporting students.

- Course Abbreviation - A common abbreviation that will be used by all community/junior colleges in reporting students.

- Classification - Courses may be classified as:
  - Vocational-technical core - A required vocational-technical course for all students.
  - Vocational-technical elective - An elective vocational-technical course.
  - Related academic course - An academic course which provides academic skills and knowledge directly related to the program area.
  - Academic core - An academic course which is required as part of the requirements for an Associate degree.

- Description - A short narrative which includes the major purpose(s) of the course and the recommended number of hours of lecture and laboratory activities to be conducted each week during a regular semester.

- Prerequisites - A listing of any prerequisite courses that must be taken prior to or on enrollment in the course.

- Competencies and Suggested Objectives - A listing of the competencies (major concepts and performances) and of the suggested student objectives that will enable students to demonstrate mastery of these competencies.

The following guidelines were used in developing the program(s) in this document and should be considered in compiling and revising course syllabi and daily lesson plans at the local level:

- The content of the courses in this document reflects approximately 75 percent of the time allocated to each course. For example, in a four semester hour course consisting of 30 hours lecture and 120 hours of laboratory activities, approximately 22 hours of lecture and 90 hours of lab should be taken by the competencies and suggested objectives identified in the course framework. The remaining 25 percent of each course should be developed at the local district level and may reflect:
  - Additional competencies and objectives within the course related to topics not found in the State framework, including activities related to specific needs of industries in the community college district.
  - Activities which develop a higher level of mastery on the existing competencies and suggested objectives.
  - Activities and instruction related to new technologies and concepts that were not prevalent at the time the current framework was developed/revised.
  - Activities which implement components of the Mississippi Tech Prep initiative, including integration of academic and vocational-technical skills and coursework, school-to-career transition activities, and articulation of secondary and postsecondary vocational-technical programs.
  - Individualized learning activities, including worksite learning activities, to better prepare individuals in the courses for their chosen occupational area.

- Sequencing of the course within a program is left to the discretion of the local district. Naturally, foundation courses related to topics such as safety, tool and equipment usage, and other fundamental skills should be taught first. Other courses related to specific skill areas and related academics, however, may be sequenced to take advantage of seasonal and climatic conditions, resources located outside of the school, and other factors.

- Programs that offer an Associate of Applied Science degree must include a minimum 15 semester credit hour academic core. Specific courses to be taken within this core are to be determined by the local district. Minimum academic core courses are as follows:
  - 3 semester credit hours Math/Science Elective
  - 3 semester credit hours Written Communications Elective
  - 3 semester credit hours Oral Communications Elective
  - 3 semester credit hours Humanities/Fine Arts Elective
  - 3 semester credit hours Social/Behavioral Science Elective

  It is recommended that courses in the academic core be spaced out over the entire length of the program, so that students complete some academic and vocational-technical courses each semester. Each community/junior college has the discretion to select the actual courses that are required to meet this academic core requirement.

- In instances where secondary programs are directly related to community and junior college programs, competencies and suggested objectives from the high school programs are listed as Baseline Competencies. These competencies and objectives reflect skills and knowledge that are directly related to the community and junior college vocational-technical program. In adopting the curriculum framework, each community and junior college is asked to give assurances that:
  - students who can demonstrate mastery of the Baseline Competencies do not receive duplicate instruction, and
  - students who cannot demonstrate mastery of this content will be given the opportunity to do so.

- The roles of the Baseline Competencies are to:
  - Assist community/junior college personnel in developing articulation agreements with high schools, and
  - Ensure that all community and junior college courses provide a higher level of instruction than their secondary counterparts

- The Baseline Competencies may be taught as special "Introduction" courses for 3-6 semester hours of institutional credit which will not count toward Associate degree requirements. Community and junior colleges may choose to integrate the Baseline Competencies into ongoing courses in lieu of offering the "Introduction" courses or may offer the competencies through special projects or individualized instruction methods.

- Technical elective courses have been included to allow community colleges and students to customize programs to meet the needs of industries and employers in their area.

# ACKNOWLEDGEMENTS


## WRITING TEAM

### Instructors

William Harris, Mississippi Gulf Coast Community College, Jackson County
John B. Brown, Mississippi Gulf Coast Community College, Perkinston
Lacon Sheppard, Jones County Junior College
Major Hudson, Pearl River Community College
James Ivey, Ingalls
Joseph Bartee, Hinds Community College

### Team Leader

Rick Crider, Research Specialist

### OVTE Staff

John White, Assistant State Supervisor, Trade, Industrial and Related Technology

### Reviewers

Practitioners:
Ted A. Bryant
Doug Case
Joseph Clark
Robin Ladner, Sr.
Gary Martens
Barry Reynolds
Robert Sanders
Anthony Shelton

Educators:
Ron Brady
Larry Crane
Jimmy Horne
Bruce Irvin
Jeanette Morrison
Larry Porter
Roosevelt Smith, Jr.

### Technical Committee for Industrial Curricula

Sam Cobbins
Larry Crimm
Dearld Dear
John DeVoe
Grady Edwards
Don Gillespie
James Ivy
Ken Riley
Joseph Simon
L.W. Smith
Fred Strohm
Jack Wynne

# TABLE OF CONTENTS

Page

FOREWORD . . . . . iii

ACKNOWLEDGEMENTS . . . . . vii

WELDING AND CUTTING PROGRAM DESCRIPTION . . . . . 1

WELDING AND CUTTING PROGRAM
SUGGESTED COURSE SEQUENCE . . . . . 2

SECTION I: BASELINE COMPETENCIES FOR
WELDING AND CUTTING PROGRAMS . . . . . 5

SECTION II: CURRICULUM GUIDE FOR
WELDING AND CUTTING PROGRAMS . . . . . 13

- Shielded Metal Arc Welding (SMAW) . . . . . 15
- Gas Metal Arc Welding (GMAW) . . . . . 16
- Welding Inspection and Testing Principles . . . . . 17
- Gas Tungsten Arc Welding (GTAW) . . . . . 18
- Flux Cored Arc Welding (FCAW) . . . . . 19
- Drawing and Welding Symbol Interpretation . . . . . 20
- Pipe Welding . . . . . 21
- Gas Metal Arc Aluminum Welding . . . . . 23
- Plasma Arc Cutting (PAC) . . . . . 24
- Oxyfuel Gas Cutting Principles and Practices . . . . . 25
- Air Carbon Arc Cutting and Gouging . . . . . 26
- Advanced Pipe Welding . . . . . 27
- Special Problem in Welding and Cutting . . . . . 28
- Work-Based Learning in Welding and Cutting . . . . . 29

SECTION III: RECOMMENDED TOOLS AND EQUIPMENT . . . . . 31

APPENDIX A: RELATED ACADEMIC TOPICS . . . . . A-1

APPENDIX B: WORKPLACE SKILLS . . . . . B-1

APPENDIX C: STUDENT COMPETENCY PROFILE . . . . . C-1

# PROGRAM DESCRIPTION

## WELDING AND CUTTING PROGRAMS

The Welding and Cutting curriculum is designed to prepare the student for entry level employment in the field of welding and cutting. The curriculum includes Shielded Metal Arc Welding (SMAW), Gas Metal Arc Welding (GMAW), Flux Cored Arc Welding (FCAW), Pipe Welding, Plasma Arc Cutting (PAC), Carbon Arc Cutting, Oxyfuel Cutting, Gas Metal Arc Aluminum Welding, and Gas Tungsten Arc Welding (GTAW).

### National Standards Developed by American Welding Society (AWS)

The welding competencies required in this curriculum were developed to coincide with the Guide for the Training and Qualification of Welding Personnel: Entry Level Welders (AWS EG2.0-95) and Specification for Qualification and Certification for Entry Level Welders (AWS QC 10-95), developed by the American Welding Society and funded by the U.S. Department Education under Grant V.244 B 3006. The contributions of this resource are hereby acknowledged.

The American Welding Society provides a series of reference materials to support this curriculum. For additional information on AWS Educational Membership contact: American Welding Society, AWS Education Department, 550 N.W. LeJeune Road, Miami, FL 33161. (800) 443-WELD. FAX: (305) 443-7559.

# WELDING AND CUTTING

## SUGGESTED COURSE SEQUENCE*

### Baseline Competencies for Welding and Cutting**

### FIRST YEAR

| | | | |
|---|---|---|---|
| 7 sch | Shielded Metal Arc Welding (SMAW) (WLV 1117) | 1 sch | Welding Inspection and Testing Principles (WLV 1171) |
| 4 sch | Gas Metal Arc Welding (GMAW) (WLV 1124) | 6 sch | Gas Tungsten Arc Welding (GTAW) (WLV 1136) |
| 4 sch | Electives' | 3 sch | Flux Cored Arc Welding (FCAW) (WLV 1143) |
| 15 sch | | 2 sch | Drawing and Welding Symbol Interpretation (WLV 1232) |
| | | 4 sch | Electives' |
| | | 2 sch | Oxyfuel Gas Cutting Principles and Practices (WLV 1242) |
| | | 18 sch | |

* Students who lack entry level skills in math, English, science, etc., will be provided related studies.

** Baseline competencies are taken from the high school Metal Trades program. Students who can document mastery of these competencies should not receive duplicate instruction. Students who cannot demonstrate mastery will be required to do so.

' VOCATIONAL/TECHNICAL ELECTIVES:
Advanced Pipe Welding (WLV 1252)
Air Carbon Arc Cutting and Gouging (WLV 1222)
Gas Metal Arc Aluminum Welding (WLV 1162)
Pipe Welding (WLV 1155)
Plasma Arc Cutting (PAC) (WLV 1212)
Special Problem in Welding and Cutting [(WLV 191(1-3)]
Work-Based Learning in Welding and Cutting [(WLV 192(1-6)]

# SECTION I:

# BASELINE COMPETENCIES

# BASELINE COMPETENCIES FOR WELDING AND CUTTING

The following competencies and suggested objectives are taken from the publication *Mississippi Curriculum Framework for Metal Trades*. These competencies and objectives represent the baseline which was used to develop the community/junior college Welding and Cutting courses. Students enrolled in postsecondary courses should either (1) have documented mastery of these competencies, or (2) be provided with these competencies before studying the advanced competencies in the Welding and Cutting program.

Baseline competencies may be integrated into existing courses in the curriculum or taught as special "Introduction" courses. The "Introduction" courses may be taught for up to six semester hours of institutional credit and may be divided into two courses. If the Baseline Competencies are to be taught as "Introduction" courses, each course should be at least 3 credit hours. The following course number(s) and description should be used:

**Course Name(s):** Introduction to Welding and Cutting, Introduction to Welding and Cutting I, or Introduction to Welding and Cutting II

**Course Abbreviation(s):** WLV 100(3-6), WLV 1013, WLV 1023

**Classification:** Vocational-Technical Core

**Description:** These courses contain the baseline competencies and suggested objectives from the high school Metal Trades curriculum which directly relate to the community college Welding and Cutting program. The courses are designed for students entering the community college who have had no previous training or documented experience in the field. (3-6 semester hours based upon existing skills for each student. May be divided into 2 courses for a maximum total of 6 hours of institutional credit.)

**Competencies and Suggested Objectives:**

1. Demonstrate the student school handbook and classroom policies.
   a. Identify policies found in the school handbook.
   b. Identify classroom rules and policies.
   *Related Academic Topics (See Appendix A): C1, C2, C3*
   *Workplace Skills (See Appendix B): WP2, WP6*
2. Review occupational and leadership opportunities in metal trades.
   a. Investigate occupational opportunities in the local area.
   b. Update the student's Career/Educational Plan.
   c. Describe leadership opportunities available from student youth organizations in the school and community, including VICA.

*Related Academic Topics (See Appendix A): C1, C4, C6*
*Workplace Skills (See Appendix B): WP2, WP3, WP6*

3. Demonstrate safety procedures used in metal trades.
   a. Apply safety rules for personal and general shop safety including eye (State Eye Safety Law provisions), ear, and body protection; general rules of shop conduct; and the use of safety color coding in metal trades.
   b. Apply general safety rules for tool and shop equipment use including use of hand tools, air and electric power tools, and other shop equipment.
   c. Apply rules and procedures associated with fire safety including procedures for handling and storing flammable liquids and proper use of fire fighting devices.

   *Related Academic Topics (See Appendix A): C2, C4, S5, S6, S8*
   *Workplace Skills (See Appendix B): WP5*
4. Demonstrate procedures for handling, storing, and disposing of hazardous materials as per current federal and state guidelines.
   a. Recognize signal words and symbols that indicate severity of a hazard.
   b. Describe methods for reducing hazardous waste.
   c. Describe procedures for storing hazardous waste.
   d. Interpret data found on a hazardous material safety data sheet.
   e. Describe general safety procedures for first aid and cleanup to follow in case of an accident involving hazardous materials.
   f. Demonstrate procedures for handling, storing, and disposing of hazardous materials as per current federal and state guidelines.

   *Related Academic Topics (See Appendix A): C1, C2, C4, S5, S8*
   *Workplace Skills (See Appendix B): WP2, WP3, WP4, WP5, WP6*
5. Calculate measurements using fractions and decimals.
   a. Solve problems using fractions including conversion for performing addition, subtraction, multiplication, and division.
   b. Solve problems using decimals, including the addition, subtraction, multiplication, and division of decimal numbers.

   *Related Academic Topics (See Appendix A): C1, C5, M1, M4, M7*
   *Workplace Skills (See Appendix B): WP1, WP2, WP6*
6. Inspect a machined part as per specifications with various instruments.
   a. Measure a three dimensional part with a steel rule to the nearest 1/32 inch.
   b. Measure a workpiece with a combination set to lay out lines to the nearest 1/32 inch and angles to the nearest degree, and find the center of a round part.
   c. Measure various workpieces with a micrometer, outside vernier micrometer, and depth micrometer using vernier and digital scales, to the nearest 0.001 inch.
   d. Distinguish between materials used in the metal trades, including ferrous, non-ferrous, and non-metallic materials.

*Related Academic Topics (See Appendix A): C1, C2, C5, M1, M2, M3, S4*
*Workplace Skills (See Appendix B): WP1, WP2, WP6*

7. Interpret blueprint symbols, abbreviations, alphabet of lines, types of views, and title blocks.
   a. Identify the meaning of common blueprint symbols including concentricity, straightness, perpendicularity, center line, and diameter.
   b. Describe the abbreviations commonly used on blueprints including the following: Cast iron (CI), Cold rolled steel (CRS), Cast steel (CS), Center to center (CC), Counterbore (C' Bore or CB), Countersink (Csk), Diameter (Dia), Finish (F or Fin), Square (SQ), Hexagon (Hex), Inside diameter (ID), Outside diameter (OD), Radius (R or Rad), Required (Req'd or Req), Pitch diameter (PD), Round (Rd), Symmetrical (SYM), Total indicator reading (TIR), Typical (TYP), Parallel (Par), United National Coarse (UNC), Unified National Fine (UNF), and American Standard Taper Pipe (NTP).
   c. Identify the alphabet of lines used on blueprints, including object lines, hidden lines, center line, extension line, dimension lines, section lines, cutting plane line, break lines, and phantom line.
   d. Identify the types of views shown on blueprints including top, front, and right side.
   e. Define the terms "dimension" including size, shape, location, and slots, and "tolerance" including the total variation permitted in the size of a part.
   f. Identify methods for showing dimensions and tolerance including linear and angular dimensions and basic size, allowance, and actual size tolerance.
   g. Interpret information found in the title block of a blueprint including drawing number, file number, name, sheet, scale, code identification number, signatures, tolerances, and revisions.

*Related Academic Topics (See Appendix A): C1, C2, C5, M1, M2, M4*
*Workplace Skills (See Appendix B): WP1, WP2, WP6*

8. Identify and describe the basic equipment, setup, and safety rules for proper use of oxyacetylene equipment.
   a. Identify and describe safety rules and instructions for using oxyacetylene equipment including protective equipment such as goggles and gloves; safety clothing requirements; clearing of work area; oxyacetylene cylinders and gases; adjusting pressure regulator valves; and care of welding hoses, torch body, cutting torch, welding tips, and spark striker.
   b. Set up oxyacetylene welding and cutting equipment including securing cylinders to hand truck or wall; removing cylinder valve caps; examining cylinder valve threads for damage and wiping clean of dust, oil, or grease with a clean dry cloth; purging cylinder valves; installing regulators; installing hoses; and installing torch body and welding/cutting tips.
   c. Prepare oxyacetylene equipment for welding, cutting, and brazing including adjustment of regulator pressure, lighting of torch, and adjustment of flame; define the terms "backfire" and "flashback"; and

state possible causes of flashback including failure to purge equipment, leaks from loose tips or tip nuts, incorrect gas pressure, tip held too close to work, insufficient volume of oxygen or acetylene, and using tip in confined area.

d. Distinguish between fusion welding and brazing and the purpose of flux.

*Related Academic Topics (See Appendix A): C1, C2, C3, M1, M2, S5, S6*
*Workplace Skills (See Appendix B): WP2, WP5, WP6*

9. Perform welding, cutting, and brazing operations with oxyacetylene equipment.
   a. Lay beads on a flat plate with and without filler rod including puddle control according to industry standards, and weld an outside corner joint in the flat position including puddle control and metal fusion.
   b. Make 90-degree cuts on mild steel including control and handling of equipment according to industry standards, and braze weld a square groove butt joint in the flat position including control of temperature of base metal and filler rod.

   *Related Academic Topics (See Appendix A): C1, C2, C3, M1, M2, S5, S6*
   *Workplace Skills (See Appendix B): WP2, WP5, WP6*
10. Identify and describe procedures and processes for SMAW.
   a. Explain safety rules related to SMAW equipment and processes including electrical safety, handling of welding cables and containers, hazards of arc rays, protective clothing, and environmental safety requirements.
   b. Describe how flux-covered electrodes work including design of the metal core with flux coating, contribution of metal to the weld, and shielding to prevent oxidation; explain the meaning of the numbers in the AWS electrode code classification including prefix, tensile strength, position, and special characteristics; and identify welding symbols.
   c. Describe the basic elements and techniques of arc welding including electrode selection, welding speed, welding position, joint preparation, fit-up, polarity, striking and maintaining an arc, arc gap, operating speed, electrode angle, movement of electrode, and the characteristics of good and bad welds by identifying the effects of current, voltage, and speed.

   *Related Academic Topics (See Appendix A): C1, C2, C3, M1, M2, M4, S5, S6*
   *Workplace Skills (See Appendix B): WP1, WP2, WP4*
11. Demonstrate proper striking and restriking of an electrode, controlling the crater, backfilling a bead, and building a pad.
   a. Strike and re-strike an arc, crater, and backfill a bead while running a bead on mild steel plate.
   b. Build a pad in the flat position on mild steel, and fabricate a butt joint and a multiple pass T-joint in flat and horizontal positions in mild steel according to specifications.

   *Related Academic Topics (See Appendix A): S5*
   *Workplace Skills (See Appendix B): WP1, WP6*

12. Identify and describe safety rules that apply to the pedestal grinder, and perform inspection, maintenance, and grinding operations.
    a. Describe safety rules that apply to the pedestal grinder including wearing safety glasses, standing to side when turning on machine, gap between wheel and rest, conducting ring test when installing wheel, and correct feed.
    b. Inspect and maintain a pedestal grinder including checking a new wheel for cracks, replacing a wheel, and dressing a wheel, and grinding a high speed tool bit and twist drill to specifications.

    *Related Academic Topics (See Appendix A): C1, C2, C5, M1, M2, M4, S4, S5*
    *Workplace Skills (See Appendix B): WP1, WP2, WP4*
13. Demonstrate proper safety practices and welding techniques for SMAW.
    a. Demonstrate and review safety rules and practices, including hand tools, power equipment, and personal safety.
    b. Construct a V-groove butt joint, a T-joint, and a lap joint in the flat position according to specifications.

    *Related Academic Topics (See Appendix A): C1, C2, M1, M4, M5, S5, S6*
    *Workplace Skills (See Appendix B): WP2, WP5, WP6*
14. Demonstrate and discuss proper GMAW safety procedures, applications, and the advantages and limitations of gas metal arc welding (GMAW), and identify the machine controls on a GMAW welder.
    a. Demonstrate safety procedures for GMAW, and describe applications for GMAW, including the welding of ferrous and non-ferrous metals.
    b. Compare the advantages and limitations of GMAW.
    c. Identify the machine controls on a GMAW welder including the function of each.

    *Related Academic Topics (See Appendix A): C1, C2, C5, M1, M4, M7, S5, S6*
    *Workplace Skills (See Appendix B): WP2, WP4, WP5*
15. Describe the short circuit transfer and spray arc metal transfer process, rules for GMAW electrode selection, uses of the common shielding gases in GMAW, and setup and shutdown of GMAW equipment.
    a. Describe the short circuit transfer and spray arc metal transfer processes.
    b. Describe rules for GMAW electrode selection including short circuit transfer uses of small diameter wires of .035" or larger and the uses of the common shielding gases in GMAW (argon, $CO_2$, and oxygen).
    c. Set up GMAW equipment, perform short circuit transfer, and shut down equipment.

    *Related Academic Topics (See Appendix A): C1, C2, C5, M1, M4, M7, S5, S6*
    *Workplace Skills (See Appendix B): WP2, WP4, WP5*
16. Perform various welds in the flat position according to specifications.
    a. Fabricate a butt joint weld, a lap joint fillet weld, a T-joint fillet weld, and a V-groove butt joint weld in the flat and horizontal positions (vertical and overhead optional) according to specifications.

*Related Academic Topics (See Appendix A): C2, C3, M1, M4, M5, S5, S6*
*Workplace Skills (See Appendix B): WP1, WP5, WP6*

17. Demonstrate and describe proper safety practices required in FCAW, FCAW procedures, and major factors to consider when selecting FCAW electrodes.
    a. Demonstrate proper safety precautions required in FCAW including hand tools, power equipment, and personal safety.
    b. Describe FCAW procedures including dual-shield and self-shielding, and the major factors to consider when selecting FCAW electrodes including deposition rate, base metal, and shielding gas.

    *Related Academic Topics (See Appendix A): C1, C2, C3, M1, M4, S5, S6*
    *Workplace Skills (See Appendix B): WP2, WP4, WP5*
18. Perform various welds in the flat position using FCAW techniques.
    a. Fabricate a multi-pass fillet weld and V-grooved butt joint weld in the flat and vertical positions (vertical and overhead optional) using FCAW techniques according to specifications.

    *Related Academic Topics (See Appendix A): C1, C2, M1, M4, M5, S5, S6*
    *Workplace Skills (See Appendix B): WP1, WP5, WP6*
19. Demonstrate and identify proper safety procedures, principles of GTAW, and setup of a GTAW welder.
    a. Demonstrate and describe proper safety precautions required in GTAW including hand tools, power equipment, and personal safety, and describe the principles of GTAW including heat generation, shielding gas, filler rod, and the different types of tungsten electrodes including color, finish, and application.
    b. Identify the major controls on a GTAW machine including the functions of each, the parts of a GTAW torch including the functions of each, and the different types of cups used on a GTAW torch including an application of each.
    c. Set up a GTAW welder including the adjustment of the flow meter regulator according to manufacturer's specifications.

    *Related Academic Topics (See Appendix A): C1, C2, C6, M1, M2, M4, S5, S6*
    *Workplace Skills (See Appendix B): WP2, WP4, WP5*
20. Perform various welds in the flat position using proper GTAW techniques.
    a. Run stringer beads in the flat and horizontal positions (vertical and overhead optional).
    b. Fabricate a square grove butt weld and a T-joint fillet weld in the flat and horizontal positions (vertical and overhead optional).

    *Related Academic Topics (See Appendix A): C1, C2, C6, M1, M2, M4, S5, S6*
    *Workplace Skills (See Appendix B): WP2, WP4, WP5*
21. Set up and apply safety procedures in operation of the plasma arc cutter (PAC).
    a. Identify the major components of a PAC.
    b. Apply safety procedures in operation of the PAC.
    c. Adjust airflow and temperature settings.

d. Operate a PAC to cut mild steel.

*Related Academic Topics (See Appendix A): C1, C2, C3, C4, C5, C6, M1, S5*
*Workplace Skills (See Appendix B): WP2, WP4*

# SECTION II:

# CURRICULUM GUIDE

# FOR

# WELDING AND CUTTING

**Course Name:** Shielded Metal Arc Welding (SMAW)

**Course Abbreviation:** WLV 1117

**Classification:** Vocational-Technical Core

**Description:** This course is designed to teach students welding techniques using electrodes. (7 sch: 1 hr. lecture, 12 hr. lab)

**Prerequisites:** None

**Competencies and Suggested Objectives:**

1. Set up equipment for shielded metal arc welding operations, and perform welds for all position fillet and groove welding within a limited thickness range of plain carbon steel material.
   a. Perform safety inspections of equipment and accessories.
   b. Make minor external repairs to equipment and accessories.
   c. Set up for shielded metal arc welding operations on plain carbon steel.
   d. Operate shielded metal arc welding equipment.
   e. Make fillet welds, all positions, on plain carbon steel.
   f. Make groove welds, all positions, on plain carbon steel.
   g. Perform 2G - 4G limited thickness qualification tests on plain carbon steel plate.

   *Related Academic Topics (See Appendix A): C1, C2, C3, C4, M7*
   *Workplace Skills (See Appendix B): WP1, WP2, WP4, WP5*

**Course Name:** Gas Metal Arc Welding (GMAW)

**Course Abbreviation:** WLV 1124

**Classification:** Vocational-Technical Core

**Description:** This course is designed to give the student experience in various welding applications with the GMAW welder including short circuiting and pulsed transfer. (4 sch: 1 hr. lecture, 6 hr. lab)

**Prerequisites:** None

**Competencies and Suggested Objectives:**

1. Set up equipment for gas metal arc welding operations, and perform welds for all position fillet and groove welding within a limited thickness range of plain carbon steel material.
   a. Perform safety inspections of equipment and accessories.
   b. Make minor external repairs to equipment and accessories.
   c. Set up for gas metal arc welding operations on plain carbon steel.
   d. Operate gas metal arc welding equipment.
   e. Short circuit transfer: Make fillet and groove welds, all positions, on plain carbon steel.
   f. Spray transfer: Make 1F - 2F welds on plain carbon steel. Make 1G welds on plain carbon steel.

   *Related Academic Topics (See Appendix A): C1, C2, C3, C4, M7*
   *Workplace Skills (See Appendix B): WP1, WP2, WP4, WP5*

**Course Name:** Welding Inspection and Testing Principles

**Course Abbreviation:** WLV 1171

**Classification:** Vocational-Technical Core

**Description:** This course is designed to give the student experience in inspection and testing of welds. (1 sch: 2 hr. lab)

**Prerequisites:** None

**Competencies and Suggested Objectives**

1. Perform visual inspection of completed welds to include removal of test specimen, preparation of test specimen, free bend test, and analysis of test specimen.
   a. Examine cut surfaces and edges of prepared base metal parts.
   b. Examine tack, intermediate layers, and completed welds.
   c. Remove, prepare, and bend designated weld areas for root, face, and bend specimens, per AWS QC 10-95.
   d. Visually inspect face and root bend specimens and evaluate for compliance with AWS QC 10-95.

   *Related Academic Topics (See Appendix A): C1, C2, C3, C4, M7, S8*
   *Workplace Skills (See Appendix B): WP1, WP2, WP4, WP5*

**Course Name:** Gas Tungsten Arc Welding (GTAW)

**Course Abbreviation:** WLV 1136

**Classification:** Vocational-Technical Core

**Description:** This course is designed to give the student experience in various welding applications with the GTAW welder. (6 sch: 1 hr. lecture, 10 hr. lab)

**Prerequisites:** None

**Competencies and Suggested Objectives:**

1. Set up equipment for gas tungsten arc welding operations, and perform welds for all position fillet and groove welding within a limited thickness range of plain carbon steel material. Perform gas tungsten arc welding operations on aluminum, stainless steel or plain carbon steel with a stainless steel filler rod.
   a. Perform safety inspections of equipment and accessories.
   b. Make minor external repairs to equipment and accessories.
   c. Set up for gas tungsten arc welding operations on plain carbon steel, aluminum, and stainless steel.
   d. Operate gas tungsten arc welding equipment.
   e. Make fillet welds, all positions, on plain carbon steel.
   f. Make groove welds, all positions, on plain carbon steel.
   g. Make 1F - 2F welds on aluminum.
   h. Make 1G welds on aluminum.
   i. Make 1F - 3F welds on stainless steel or carbon steel using stainless steel filler rod.
   j. Make 1G - 2G on stainless steel or carbon steel using stainless steel filler rod.

   *Related Academic Topics (See Appendix A): C1, C2, C3, C4, M7*
   *Workplace Skills (See Appendix B): WP1, WP2, WP4, WP5*

**Course Name:** Flux Cored Arc Welding (FCAW)

**Course Abbreviation:** WLV 1143

**Classification:** Vocational-Technical Core

**Description:** This course is designed to give the student experience in FCAW. (3 sch: 1 hr. lecture, 4 hr. lab)

**Prerequisites:** None

**Competencies and Suggested Objectives:**

1. Set up equipment for flux cored arc welding operations, and perform welds for all position fillet and groove welding within a limited thickness range of plain carbon steel material.
   a. Perform safety inspections of equipment and accessories.
   b. Make minor external repairs to equipment and accessories.
   c. Set up for flux cored arc welding operations on plain carbon steel.
   d. Operate flux cored arc welding equipment.
   e. Make fillet welds, all positions, on plain carbon steel.
   f. Make groove welds, all positions, on plain carbon steel.

   *Related Academic Topics (See Appendix A): C1, C2, C3, C4, M7*
   *Workplace Skills (See Appendix B): WP1, WP2, WP4, WP5*

**Course Name:** Drawing and Welding Symbol Interpretation

**Course Abbreviation:** WLV 1232

**Classification:** Vocational-Technical Core

**Description:** This course is designed to give the student advanced experience in reading welding symbols. (2 sch: 1 hr. lecture, 2 hr. lab)

**Prerequisites:** None

**Competencies and Suggested Objectives:**

1. Prepare parts from simple sketches or drawings; perform welding operations and prepare welded joints from welding symbol information.
   a. Interpret basic elements of a drawing or sketch.
   b. Interpret welding symbol information.
   c. Fabricate parts from a drawing or sketch.

   *Related Academic Topics (See Appendix A): C1, C2, C3, C4, M7, S8*
   *Workplace Skills (See Appendix B): WP1, WP2, WP4, WP5*

**Course Name:** Pipe Welding

**Course Abbreviation:** WLV 1155

**Classification:** Vocational-Technical Elective

**Description:** This course is designed to give the student experience in pipe welding procedures. (5 sch: 1 hr. lecture, 8 hr. lab)

**Prerequisites:** Shielded Metal Arc Welding (SMAW) (WLV 1117) and Gas Tungsten Arc Welding (GTAW) (WLV 1136)

**Competencies and Suggested Objectives:**

1. Demonstrate safety precautions, and identify pipe weld test positions.
   a. Demonstrate safety precautions required in pipe welding.
   b. Name four pipe welding test positions.
   *Related Academic Topics (See Appendix A): C1, C2, C3, C4, M7*
   *Workplace Skills (See Appendix B): WP1, WP2, WP4, WP5*
2. Describe differences in pipe and tubing, faults in pipe welding, and determine thickness limit for pipe welding.
   a. Describe the difference between pipe and tubing.
   b. Name and describe the two most common faults in pipe welding (lack of and too much penetration).
   c. Determine the thickness limit for welding pipe down hill (less than ½ inch.)
   *Related Academic Topics (See Appendix A): C1, C2, C3, C4, M7*
   *Workplace Skills (See Appendix B): WP1, WP2, WP4, WP5*
3. Use correct methods for preparation and fitting of pipe, and demonstrate correct pipe welding procedures.
   a. Use correct methods of pipe preparation and fit.
   b. Demonstrate correct pipe welding procedures.
   *Related Academic Topics (See Appendix A): C1, C2, C3, C4, M7*
   *Workplace Skills (See Appendix B): WP1, WP2, WP4, WP5*
4. Perform open V-grooved pipe welds and bend tests.
   a. Fabricate and weld an open V-grooved pipe weld in the 2G and 5G positions using E-6010 and E-7018 electrodes, and test (bend).
   b. Pass a guided bend test on an open butt.
   *Related Academic Topics (See Appendix A): C1, C2, C3, C4, M7*
   *Workplace Skills (See Appendix B): WP1, WP2, WP4, WP5*
5. Perform open butt V-groove pipe welds and bend tests.
   a. Fabricate and weld an open butt V-grooved pipe weld in the 2G and 5G positions using GTAW and E-7018 electrodes.

b. Pass a guided bend test on open butt V-grooved pipe weld in the 6G position using GTAW and E-7018 electrodes as per AWS DI.I Code.

*Related Academic Topics (See Appendix A): C1, C2, C3, C4, M7*
*Workplace Skills (See Appendix B): WP1, WP2, WP4, WP5*

**Course Name:** Gas Metal Arc Aluminum Welding

**Course Abbreviation:** WLV 1162

**Classification:** Vocational-Technical Elective

**Description:** This course is designed to give the student experience in Gas Metal Aluminum Welding. (2 sch: 1 hr. lecture, 2 hr. lab)

**Prerequisites:** None

**Competencies and Suggested Objectives:**

1. Identify aluminum alloys, aluminum weldability, and results of welding aluminum.
   a. List three advantages of aluminum alloys.
   b. Identify three factors that make aluminum difficult to weld.
   c. Name three results that must be obtained when welding aluminum.

   *Related Academic Topics (See Appendix A): C1, C2, C3, C4, M7*
   *Workplace Skills (See Appendix B): WP1, WP2, WP4, WP5*
2. Fabricate and weld multi-pass fillet welds.
   a. Fabricate and weld multi-pass fillet weld and V-grooved butt joint in the horizontal, vertical, and overhead positions using aluminum alloys.

   *Related Academic Topics (See Appendix A): C1, C2, C3, C4, M7*
   *Workplace Skills (See Appendix B): WP1, WP2, WP4, WP5*

**Course Name:** Plasma Arc Cutting (PAC)

**Course Abbreviation:** WLV 1212

**Classification:** Vocational-Technical Elective

**Description:** This course is designed to give the student experience in PAC. (2 sch: 1 hr. lecture, 2 hr. lab)

**Prerequisites:** None

**Competencies and Suggested Objectives:**

1. Perform shape cutting operations using the manual plasma arc cutting process.
   a. Perform safety inspections of equipment and accessories.
   b. Make minor external repairs to equipment and accessories.
   c. Set up for manual plasma arc cutting operations on plain carbon steel, aluminum, and stainless steel.
   d. Operate manual plasma arc cutting equipment.
   e. Perform shape cutting operations on plain carbon steel, aluminum, and stainless steel.

   *Related Academic Topics (See Appendix A): C1, C2, C3, C4, M7*
   *Workplace Skills (See Appendix B): WP1, WP2, WP4, WP5*

**Course Name:** Oxyfuel Gas Cutting Principles and Practices

**Course Abbreviation:** WLV 1242

**Classification:** Vocational-Technical Core

**Description:** This course is designed to give the student experience in oxyfuel cutting principles and practices. (2 sch: 1 hr. lecture, 2 hr. lab)

**Prerequisites:** None

**Competencies and Suggested Objectives:**

1. Set up and perform manual oxyfuel gas cutting operations.
   a. Perform safety inspections of equipment and accessories.
   b. Make minor external repairs to equipment and accessories.
   c. Set up for manual oxyfuel gas cutting operations on plain carbon steel.
   d. Operate manual oxyfuel cutting equipment.
   e. Perform straight cutting operations on plain carbon steel.
   f. Perform shape cutting operations on plain carbon steel.
   g. Perform bevel cutting operations on plain carbon steel.
   h. Remove weld metal from plain carbon steel using weld washing techniques.

   *Related Academic Topics (See Appendix A): C1, C2, C3, C4, M7*
   *Workplace Skills (See Appendix B): WP1, WP2, WP4, WP5*
2. Set up and operate machine oxyfuel gas cutting equipment (track burner) to perform cutting operations.
   a. Perform safety inspections of equipment and accessories.
   b. Make minor external repairs to equipment and accessories.
   c. Set up for machine oxyfuel gas cutting (track burner) operations on plain carbon steel.
   d. Operate machine oxyfuel gas cutting (track burner) equipment.
   e. Perform straight cutting operations on plain carbon steel.
   f. Perform bevel cutting operations on plain carbon steel.

   *Related Academic Topics (See Appendix A): C1, C2, C3, C4, M7*
   *Workplace Skills (See Appendix B): WP1, WP2, WP4, WP5*

**Course Name:** Air Carbon Arc Cutting and Gouging

**Course Abbreviation:** WLV 1222

**Classification:** Vocational-Technical Elective

**Description:** This course is designed to give the student experience in Air Carbon Cutting and Gouging. (2 sch: 1 hr. lecture, 2 hr. lab)

**Prerequisites:** None

**Competencies and Suggested Objectives:**

1. Set up and perform metal removal using the carbon arc cutting process.
   a. Perform safety inspections of equipment and accessories.
   b. Make minor external repairs to equipment and accessories.
   c. Set up for manual air carbon arc gouging and cutting operations on plain carbon steel.
   d. Operate manual air carbon arc cutting equipment.
   e. Perform metal removal operations on plain carbon steel.

   *Related Academic Topics (See Appendix A): C1, C2, C3, C4, M7*
   *Workplace Skills (See Appendix B): WP1, WP2, WP4, WP5*

**Course Name:** Advanced Pipe Welding

**Course Abbreviation:** WLV 1252

**Classification:** Vocational-Technical Elective

**Description:** This course is designed to give the student advanced pipe welding techniques using shielded metal arc and gas tungsten arc welding processes. (2 sch: 1 hr. lecture, 2 hr. lab)

**Prerequisites:** Pipe Welding (WLV 1155)

**Competencies and Suggested Objectives:**

1. Fabricate and weld pipe according to specifications.
   a. Fabricate and weld an open butt V-grooved pipe weld in the 5G position using the down hill technique.
   b. Fabricate and weld an open butt V-grooved 2 inch pipe weld in the 6G position utilizing the GTAW process.

   *Related Academic Topics (See Appendix A): C1, C2, C3, C4, M7*
   *Workplace Skills (See Appendix B): WP1, WP2, WP4, WP5*

**Course Name:** Special Problem in Welding and Cutting

**Course Abbreviation:** WLV 191(1-3)

**Classification:** Vocational-Technical Elective

**Description:** A course designed to provide the student with practical application of skills and knowledge gained in other Welding and Cutting courses. The instructor works closely with the student to insure that the selection of a project will enhance the student's learning experience. (1-3 sch: 2-6 hr. lab)

**Prerequisites:** Consent of instructor

**Competencies and Suggested Objectives:**

1. Prepare a written agreement.
   a. Compile a written training agreement in cooperation with the instructor and student which details work schedule and specific tasks/skills to be mastered in the program.

   *Related Academic Skills (See Appendix A): C1, C2, C3, C4, C5, C6*
   *Workplace Skills (See Appendix B): WP1, WP2, WP3, WP6*
2. Prepare a written report of activities.
   a. Compile a daily log of activities and tasks.
   b. Submit weekly reports to the instructor summarizing activities and tasks completed.
   c. Submit a final report of activities and experiences.

   *Related Academic Skills (See Appendix A): C1, C2, C4, C6*
   *Workplace Skills (See Appendix B): WP1, WP2, WP6*
3. Follow written guidelines for work experience programs.
   a. Complete all required activities in the training programs.
   b. Adhere to all written and oral instructions for the supervised experience.

   *Related Academic Skills (See Appendix A): C1, C2, C3, C4, C5, M7, S8*
   *Workplace Skills (See Appendix B): WP1, WP2, WP3, WP4, WP5, WP6*

**Course Name:** Work-Based Learning in Welding and Cutting

**Course Abbreviation:** WLV 192(1-6)

**Classification:** Vocational-Technical Elective

**Description:** This course is a cooperative program between the industry and education and is designed to integrate the student's technical studies with industrial experience. Variable credit is awarded on the basis of 1 semester hour per 45 contact hours. (1-6 sch variable: 3-18 hr., externship)

**Prerequisites:** Minimum of 12 sch Welding and Cutting related courses or consent of instructor

**Competencies and Suggested Objectives:**

1. Apply technical skills needed to be a viable member of the work force.
   a. Prepare a description of technical skills to be developed in the work-based learning program.
   b. Develop technical skills needed to be a viable member to the work force.
   *Related Academic Topics (See Appendix A): C5, C6*
   *Workplace Skills (See Appendix B): WP1*
2. Apply skills developed in other program area courses.
   a. Perform skills developed in other program area courses in the work-based learning program.
   *Related Academic Topics (See Appendix A): C5, C6*
   *Workplace Skills (See Appendix B): WP5, WP6*
3. Apply human relationship skills.
   a. Use pro-active human relationship skills in the work-based learning program.
   *Related Academic Topics (See Appendix A): C5, C6*
   *Workplace Skills (See Appendix B): WP3*
4. Apply and practice positive work habits and responsibilities.
   *Related Academic Topics (See Appendix A): C5, C6*
   *Workplace Skills (See Appendix B): WP3*
5. Work with instructor and employer to develop written occupational objectives to be accomplished.
   a. Perform written occupational objectives in the work-based learning program.
   *Related Academic Topics (See Appendix A): C5, C6*
   *Workplace Skills (See Appendix B): WP6*
6. Assess accomplishment of objectives.
   a. Prepare daily written assessment of accomplishment of objectives.

b. Present weekly written reports to instructor in activities performed and objectives accomplished.

*Related Academic Topics (See Appendix A): C5, C6*
*Workplace Skills (See Appendix B): *WP6*

7. Utilize a set of written guidelines for the work-based learning program.
   a. Develop and follow a set of written guidelines for the work-based learning program.

*Related Academic Topics (See Appendix A): C5, C6*
*Workplace Skills (See Appendix B): WP6*

# SECTION III:

# RECOMMENDED TOOLS AND EQUIPMENT

# RECOMMENDED TOOLS AND EQUIPMENT FOR WELDING AND CUTTING PROGRAMS

Welding

1. First aid kit (1 each)
2. Emergency eye wash station (1 each)
3. Work bench with medium duty vise (4 each)
4. 8" C-clamps (1 set)
5. 4½" Right angle grinder (3 each)
6. 9" Right angle grinder (3 each)
7. Oxyfuel burning table with dross pan and replaceable slats (4'x8'x31") (1 each)
8. Work area protective screens (as required) (1 for each welding booth)
9. Exhaust system (1 each)
10. Guided bend test jig or machine (hydraulic) (1 each)
11. Framing squares (24"x18") (6 each)
12. Compressed air supply and accessories (min. delivery 80 psi @ 8 cfm per station) (1 each)
13. Compressed air hose (50') with retractable reel (2 each)
14. Compressed air regulator (1 each)
15. Male and female quick couples and adaptors (1 each)
16. Hose repair kit with crimping tool for oxyfuel cutting equipment (1 each)
17. Plasma arc cutting device with min. ½" cutting depth (2 each)
18. Combination (multi-process) machine with power source (6 or 8 pack) with cables and accessories for 4 GTAW and 4 GMAW setup (13 each)
19. Shielded metal arc welding machines (AC/DC - constant current 250-300 amp @ 60%) with cables and accessories (13 each)
20. Oxyfuel gas cutting equipment with regulators, hoses, torch, tips, cart, and accessories (5 sets)
21. Machine oxyfuel gas cutting equipment with regulators, hoses, torch, tips, rails or track, and accessories (1 set)
22. Leather jacket, cape, sleeves or apron leather gloves (new program) (2 sets)
23. Safety glasses with side shields and a sanitizing cabinet (1 set)
24. Burning goggles or face shield (5 each)
25. #5 Filter plate/lens for burning goggles (2 each)
26. Clear cover plate/lens for burning goggles (4 each)
27. Welding helmet (20 each)
28. Welding lenses to match helmet, #10 shaded filter plate/lens (2 each)
29. Clear cover plate/lens for welding helmets (4 each)
30. Stainless steel wire brush (20 each)
31. 16 ounce ball peen hammer (4 each)
32. Electric hand drill (¼", ⅜", ½" chuck) (1 each)
33. Center punches (1 set)
34. Metal scribe (6 each)

35. Steel dividers (radius maker, min. 6") (2 each)
36. Steel tape measure (minimum 10') (20 each)
37. Combination square set (4 each)
38. Chipping hammer (20 each)
39. 10" mill file (half round-bastard cut) (20 each)
40. Cold chisels (1 set)
41. Adjustable wrenches (12", 10", 8", 6") (1 set)
42. Tank wrench (2 each)
43. 10" groove or slip joint pliers (8 each)
44. 6" combination side cutting/needle nose pliers (10 each)
45. 10" vice grips (4 each)
46. 10" vice grip clamp or tongs (20 each)
47. Allen or hex wrenches (to ⅜") (2 sets)
48. Screwdrivers flat head (1 set)
49. Screwdrivers Phillip's head (1 set)
50. Oxyfuel friction lighter, with flints and tip cleaners (12 each)
51. Fillet gages (2 sets)
52. Ironworker (1 each)
53. Pedestal grinder (2 each)
54. Large drill press (1 each)
55. Small drill press (1 each)
56. Band saw (vertical or horizontal) (1 each)
57. Portable abrasive cutoff saw (min. 20") (1 each)
58. Heavy duty four wheel material mover (1 each)
59. Crane (a-frame) heavy duty (1 each)
60. Carbon arc gouging whip (2 each)
61. Steel wire brush (20)
62. Pipe bevel machine for mild steel (oxyfuel) (1)
63. Welder, engine driven (200 amps, constant current/constant voltage @60% duty cycle) (1)
64. Electrode shop oven (1)

## RECOMMENDED INSTRUCTIONAL AIDS

1. Calculator (1)
2. Cart, AV (for overhead projector) (1)
3. Cart, AV (for TV-VCR) (1)
4. Projector, overhead (1)
5. TV-VCR (1)
6. Video out (Microcomputer to TV monitor) (1)
7. Microcomputer with CD-ROM, SVGA Graphics Card, and Modem and Operating Software (1)

8. AWS. Welding Educator's Library, Miami, FL: American Welding Society, 1995.
9. AWS. Safety in Welding and Cutting (ANSI/ASC Z49.1-88). Miami, FL: American Welding Society, 1988. (1)

# APPENDIX A:

# RELATED ACADEMIC TOPICS

# APPENDIX A

## RELATED ACADEMIC TOPICS FOR COMMUNICATIONS

C1 Interpret written material.
C2 Interpret visual materials (maps, charts, graphs, tables, etc.).
C3 Listen, comprehend, and take appropriate actions.
C4 Access, organize, and evaluate information.
C5 Use written and/or oral language skills to work cooperatively to solve problems, make decisions, take actions, and reach agreement.
C6 Communicate ideas and information effectively using various oral and written forms for a variety of audiences and purposes.

## EXPANDED TOPICS FOR COMMUNICATIONS

### TOPIC C1: Interpret written material.

C1.01 Read and follow complex written directions.
C1.02 Recognize common words and meanings associated with a variety of occupations.
C1.03 Adjust reading strategy to purpose and type of reading.
C1.04 Use sections of books and reference sources to obtain information.
C1.05 Compare information from multiple sources and check validity.
C1.06 Interpret items and abbreviations used in multiple forms.
C1.07 Interpret short notes, memos, and letters.
C1.08 Comprehend technical words and concepts.
C1.09 Use various reading techniques depending on purpose for reading.
C1.10 Find, read, understand, and use information from printed matter or electronic sources.

### TOPIC C2: Interpret visual materials (maps, charts, graphs, tables, etc.).

C2.01 Use visuals in written and in oral presentations.
C2.02 Recognize visual cues to meaning (layout, typography, etc.).
C2.03 Interpret and apply information using visual materials.

### TOPIC C3: Listen, comprehend, and take appropriate action.

C3.01 Identify and evaluate orally-presented messages according to purpose.
C3.02 Recognize barriers to effective listening.
C3.03 Recognize how voice inflection changes meaning.
C3.04 Identify speaker signals requiring a response and respond accordingly.
C3.05 Listen attentively and take accurate notes.
C3.06 Use telephone to receive information.

C3.07 Analyze and distinguish information from formal and informal oral presentations.

TOPIC C4: Access, organize, and evaluate information.

C4.01 Distinguish fact from opinion.
C4.02 Use various print and non-print sources for specialized information.
C4.03 Interpret and distinguish between literal and figurative meaning.
C4.04 Interpret written or oral communication in relation to context and writer's point of view.
C4.05 Use relevant sources to gather information for written or oral communication.

TOPIC C5: Use written and/or oral language skills to work cooperatively to solve problems, make decisions, take actions, and reach agreement.

C5.01 Select appropriate words for communication needs.
C5.02 Use reading, writing, listening, and speaking skills to solve problems.
C5.03 Compose inquiries and requests.
C5.04 Write persuasive letters and memos.
C5.05 Edit written reports, letters, memos, and short notes for clarity, correct grammar, and effective sentences.
C5.06 Write logical and understandable statements, phrases, or sentences for filling out forms, for correspondence or reports.
C5.07 Write directions or summaries of processes, mechanisms, events, or concepts.
C5.08 Select and use appropriate formats for presenting reports.
C5.09 Convey information to audiences in writing.
C5.10 Compose technical reports and correspondence that meet accepted standards for written communications.

TOPIC C6: Communicate ideas and information using oral and written forms for a variety of audiences and purposes.

C6.01 Give complex oral instructions.
C6.02 Describe a business or industrial process/mechanism.
C6.03 Participate effectively in group discussions and decision making.
C6.04 Produce effective oral messages utilizing different media.
C6.05 Explore ideas orally with partners.
C6.06 Participate in conversations by volunteering information when appropriate and asking relevant questions when appropriate.
C6.07 Restate or paraphrase a conversation to confirm one's own understanding.
C6.08 Gather and provide information utilizing different media.

C6.09 Prepare and deliver persuasive, descriptive, and demonstrative oral presentations.

## RELATED ACADEMIC TOPICS FOR MATHEMATICS

M1 Relate number relationships, number systems, and number theory.
M2 Explore patterns and functions.
M3 Explore algebraic concepts and processes.
M4 Explore the concepts of measurement.
M5 Explore the geometry of one-, two-, and three-dimensions.
M6 Explore concepts of statistics and probability in real world situations.
M7 Apply mathematical methods, concepts, and properties to solve a variety of real-world problems.

## EXPANDED TOPICS FOR MATHEMATICS

TOPIC M1: Relate number relationships, number systems, and number theory.

M1.01 Understand, represent, and use numbers in a variety of equivalent forms (integer, fraction, decimal, percent, exponential, and scientific notation) in real world and mathematical problem situations.
M1.02 Develop number sense for whole numbers, fractions, decimals, integers, and rational numbers.
M1.03 Understand and apply ratios, proportions, and percents in a wide variety of situations.
M1.04 Investigate relationships among fractions, decimals, and percents.
M1.05 Compute with whole numbers, fractions, decimals, integers, and rational numbers.
M1.06 Develop, analyze, and explain procedures for computation and techniques for estimations.
M1.07 Select and use an appropriate method for computing from among mental arithmetic, paper-and-pencil, calculator, and computer methods.
M1.08 Use computation, estimation, and proportions to solve problems.
M1.09 Use estimation to check the reasonableness of results.

TOPIC M2: Explore patterns and functions.

M2.01 Describe, extend, analyze, and create a wide variety of patterns.
M2.02 Describe and represent relationships with tables, graphs, and rules.
M2.03 Analyze functional relationships to explain how a change in one quantity results in a change in another.
M2.04 Use patterns and functions to represent and solve problems.
M2.05 Explore problems and describe results using graphical, numerical, physical, algebraic, and verbal mathematical models or representations.

M2.06 Use a mathematical idea to further their understanding of other mathematical ideas.
M2.07 Apply mathematical thinking and modeling to solve problems that arise in other disciplines, such as art, music, and business.

TOPIC M3: Explore algebraic concepts and processes.

M3.01 Represent situations and explore the interrelationships of number patterns with tables, graphs, verbal rules, and equations.
M3.02 Analyze tables and graphs to identify properties and relationships and to interpret expressions and equations.
M3.03 Apply algebraic methods to solve a variety of real world and mathematical problems.

TOPIC M4: Explore the concepts of measurement.

M4.01 Estimate, make, and use measurements to describe and compare phenomena.
M4.02 Select appropriate units and tools to measure to the degree of accuracy required in a particular situation.
M4.03 Extend understanding of the concepts of perimeter, area, volume, angle measure, capacity, and weight and mass.
M4.04 Understand and apply reasoning processes, with special attention to spatial reasoning and reasoning with proportions and graphs.

TOPIC M5: Explore the geometry of one-, two-, and three-dimensions.

M5.01 Identify, describe, compare, and classify geometric figures.
M5.02 Visualize and represent geometric figures with special attention to developing spatial sense.
M5.03 Explore transformations of geometric figures.
M5.04 Understand and apply geometric properties and relationships.
M5.05 Classify figures in terms of congruence and similarity and apply these relationships.

TOPIC M6: Explore the concepts of statistics and probability in real world situations.

M6.01 Systematically collect, organize, and describe data.
M6.02 Construct, read, and interpret tables, charts, and graphs.
M6.03 Develop an appreciation for statistical methods as powerful means for decision making.
M6.04 Make predictions that are based on exponential or theoretical probabilities.

M6.05 Develop an appreciation for the pervasive use of probability in the real world.

TOPIC M7: Apply mathematical methods, concepts, and properties to solve a variety of real-world problems.

M7.01 Use computers and/or calculators to process information for all mathematical situations.
M7.02 Use problem-solving approaches to investigate and understand mathematical content.
M7.03 Formulate problems from situations within and outside mathematics.
M7.04 Generalize solutions and strategies to new problem situations.

**RELATED ACADEMIC TOPICS FOR SCIENCE**

S1 Explain the Anatomy and Physiology of the human body.
S2 Apply the basic biological principles of Plants, Viruses and Monerans, Algae, Protista, and Fungi.
S3 Relate the nine major phyla of the kingdom animalia according to morphology, anatomy, and physiology.
S4 Explore the chemical and physical properties of the earth to include Geology, Meteorology, Oceanography, and the Hydrologic Cycle.
S5 Investigate the properties and reactions of matter to include symbols, formulas and nomenclature, chemical equations, gas laws, chemical bonding, acid-base reactions, equilibrium, oxidation-reduction, nuclear chemistry, and organic chemistry.
S6 Explore the principles and theories related to motion, mechanics, electricity, magnetism, light energy, thermal energy, wave energy, and nuclear physics.
S7 Explore the principles of genetic and molecular Biology to include the relationship between traits and patterns of inheritance, population genetics, the structure and function of DNA, and current applications of DNA technology.
S8 Apply concepts related to the scientific process and method to include safety procedures for classroom and laboratory; use and care of scientific equipment; interrelationships between science, technology and society; and effective communication of scientific results in oral, written, and graphic form.

EXPANDED TOPICS FOR SCIENCE

TOPIC S1: Explain the Anatomy and Physiology of the human body.

S1.01 Recognize common terminology and meanings.
S1.02 Explore the relationship of the cell to more complex systems within the body.

S1.03 Summarize the functional anatomy of all the major body systems.
S1.04 Relate the physiology of the major body systems to its corresponding anatomy.
S1.05 Compare and contrast disease transmission and treatment within each organ system.
S1.06 Explore the usage of medical technology as related to human organs and organ systems.
S1.07 Explain the chemical composition of body tissue.

TOPIC S2: Apply the basic biological principles of Plants, Viruses and Monerans, Algae, Protista, and Fungi.

S2.01 Identify the major types and structures of plants, viruses, monera, algae protista, and fungi.
S2.02 Explain sexual and asexual reproduction.
S2.03 Describe the ecological importance of plants as related to the environment.
S2.04 Analyze the physical chemical and behavioral process of a plant.

TOPIC S3: Relate the nine major phyla of the kingdom animalia according to morphology, anatomy, and physiology.

S3.01 Explain the morphology, anatomy, and physiology of animals.
S3.02 Describe the characteristics, behaviors, and habitats of selected animals.

TOPIC S4: Explore the chemical and physical properties of the earth to include Geology, Meteorology, Oceanography, and the Hydrologic Cycle.

S4.01 Examine minerals and their identification, products of the rock cycle, byproducts of weathering, and the effects of erosion.
S4.02 Relate the Hydrologic Cycle to include groundwater its zones, movement, and composition; surface water systems, deposits, and runoff.
S4.03 Consider the effects of weather and climate on the environment.
S4.04 Examine the composition of seawater; wave, tides, and currents; organisms, environment, and production of food; energy, food and mineral resources of the oceans.

TOPIC S5: Investigate the properties and reactions of matter to include symbols, formulas and nomenclature, chemical equations, gas laws, chemical bonding, acid-base reactions, equilibrium, oxidation-reduction, nuclear chemistry, and organic chemistry.

S5.01 Examine the science of chemistry to include the nature of matter, symbols, formulas and nomenclature, and chemical equations.

S5.02 Identify chemical reactions including precipitation, acids-bases, and reduction-oxidation.
S5.03 Explore the fundamentals of chemical bonding and principles of equilibrium.
S5.04 Relate the behavior of gases.
S5.05 Investigate the structure, reactions, and uses of organic compounds; and investigate nuclear chemistry and radiochemistry.

TOPIC S6: Explore the principles and theories related to motion, mechanics, electricity, magnetism, light energy, thermal energy, wave energy, and nuclear physics.

S6.01 Examine fundamentals of motion of physical bodies and physical dynamics.
S6.02 Explore the concepts and relationships among work, power, and energy.
S6.03 Explore principles, characteristics, and properties of electricity, magnetism, light energy, thermal energy, and wave energy.
S6.04 Identify principles of modern physics related to nuclear physics.

TOPIC S7: Explore the principles of genetic and molecular Biology to include the relationship between traits and patterns of inheritance; population genetics, the structure and function of DNA, and current applications of DNA technology.

S7.01 Examine principles, techniques, and patterns of traits and inheritance in organisms.
S7.02 Apply the concept of population genetics to both microbial and multicellular organism.
S7.03 Identify the structure and function of DNA and the uses of DNA technology in science, industry, and society.

TOPIC S8: Apply concepts related to the scientific process and method to include safety procedures for classroom and laboratory; use and care of scientific equipment; interrelationships between science, technology and society; and effective communication of scientific results in oral, written, and graphic form.

S8.01 Apply the components of scientific processes and methods in classroom and laboratory investigations.
S8.02 Observe and practice safe procedures in the classroom and laboratory.
S8.03 Demonstrate proper use and care for scientific equipment.
S8.04 Investigate science careers, and advances in technology.
S8.05 Communicate results of scientific investigations in oral, written, and graphic form.

# APPENDIX B:

# WORKPLACE SKILLS

# APPENDIX B
# WORKPLACE SKILLS FOR THE 21ST CENTURY

WP1 Allocates resources (time, money, materials and facilities, and human resources).

WP2 Acquires, evaluates, organizes and maintains, and interprets/communicates information, including the use of computers.

WP3 Practices interpersonal skills related to careers including team member participation, teaching other people, serving clients/customers, exercising leadership, negotiation, and working with culturally diverse.

WP4 Applies systems concept including basic understanding, monitoring and correction system performance, and designing and improving systems.

WP5 Selects, applies, and maintains/troubleshoots technology.

WP6 Employs thinking skills including creative thinking, decision making, problem solving, reasoning, and knowing how to learn.

# APPENDIX C:

# STUDENT COMPETENCY PROFILE

# STUDENT COMPETENCY PROFILE

Student: _____

This record is intended to serve as a method of noting student achievement of the competencies in each course. It can be duplicated for each student and serve as a cumulative record of competencies achieved in the program.

In the blank before each competency, place the date on which the student mastered the competency.

Shielded Metal Arc Welding (SMAW) (WLV 1117)

_____ 1. Set up equipment for shielded metal arc welding operations, and perform welds for all position fillet and groove welding within a limited thickness range of plain carbon steel material.

Gas Metal Arc Welding (GMAW) (WLV 1124)

_____ 1. Set up equipment for gas metal arc welding operations, and perform welds for all position fillet and groove welding within a limited thickness range of plain carbon steel material.

Welding Inspection and Testing Principles (WLV 1171)

_____ 1. Perform visual inspection of completed welds to include removal of test specimen, preparation of test specimen, free bend test, and analysis of test specimen.

Gas Tungsten Arc Welding (GTAW) (WLV 1136)

_____ 1. Set up equipment for gas tungsten arc welding operations, and perform welds for all position fillet and groove welding within a limited thickness range of plain carbon steel material. Perform gas tungsten arc welding operations on aluminum, stainless steel or plain carbon steel with a stainless steel filler rod.

Flux Cored Arc Welding (FCAW) (WLV 1143)

_____ 1. Set up equipment for flux cored arc welding operations, and perform welds for all position fillet and groove welding within a limited thickness range of plain carbon steel material.

Drawing and Welding Symbol Interpretation (WLV 1232)

_____ 1. Prepare parts from simple sketches or drawings; perform welding operations and prepare welded joints from welding symbol information.

Pipe Welding (WLV 1155)

_____ 1. Demonstrate safety precautions, and identify pipe weld test positions.
_____ 2. Describe differences in pipe and tubing, faults in pipe welding, and determine thickness limit for pipe welding.
_____ 3. Use correct methods for preparation and fitting of pipe, and demonstrate correct pipe welding procedures.
_____ 4. Perform open V-grooved pipe welds and bend tests.
_____ 5. Perform open butt V-groove pipe welds and bend tests.

Gas Metal Arc Aluminum Welding (WLV 1162)

_____ 1. Identify aluminum alloys, aluminum weldability, and results of welding aluminum.
_____ 2. Fabricate and weld multi-pass fillet welds.

Plasma Arc Cutting (PAC) (WLV 1212)

_____ 1. Perform shape cutting operations using the manual plasma arc cutting process.

Oxyfuel Gas Cutting Principles and Practices (WLV 1242)

_____ 1. Set up and perform manual oxyfuel gas cutting operations.
_____ 2. Set up and operate machine oxyfuel gas cutting equipment (track burner) to perform cutting operations.

Air Carbon Arc Cutting and Gouging (WLV 1222)

_____ 1. Set up and perform metal removal using the carbon arc cutting process.

Advanced Pipe Welding (WLV 1252)

_____ 1. Fabricate and weld pipe according to specifications.

Special Problem in Welding and Cutting (WLV 191(1-3))

_____ 1. Prepare a written agreement.
_____ 2. Prepare a written report of activities.
_____ 3. Follow written guidelines for work experiences programs.

Work-Based Learning in Welding and Cutting (WLV 192(1-6))

_____ 1. Apply technical skills needed to be a viable member of the work force.
_____ 2. Apply skills developed in other program area courses.
_____ 3. Apply human relationship skills.
_____ 4. Apply and practice positive work habits and responsibilities.
_____ 5. Work with instructor and employer to develop written occupational objectives to be accomplished.
_____ 6. Assess accomplishment of objectives.
_____ 7. Utilize a set of written guidelines for the written guidelines for the work-based learning program.